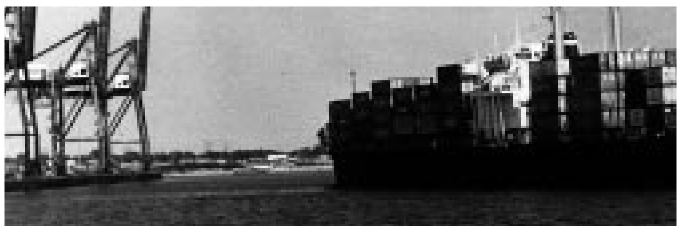
chapter two

Transportation and the Economy



Transportation is an indispensable component of any economy and society. It can increase the value of goods by moving them to locations where they are worth more. It allows people to commute to places of employment where their time has higher value. By extending the spatial boundaries of commodity and labor markets, transportation encourages competition and production. Transportation stimulates demand for various goods and services, thereby contributing to U.S. economic growth. To meet this demand, the transportation sector employs millions of workers.

This chapter begins with a discussion of the importance of transportation in the economy, followed by an analysis of consumer expenditures for transportation over the past decade, categorized by region, race, and sex. It continues with transportation-related employment and labor productivity in the transportation industry by mode, and ends with a discussion of government transportation expenditures and revenues.

Transportation's Economic Importance

The economic importance of transportation can be measured either from the demand side or from the supply side. From the demand side, gross domestic product

(GDP)[1] is the net value of goods and services produced by the economy in a given year; the importance of transportation from the demand side is measured as the share of transportation-related final demand (defined below). From the supply side, GDP is the income generated (or value-added) by all industries of the economy in the production of goods and services; the importance of transportation is measured as the share of value-added originating from the for-hire transportation industry.[2] GDP adds up to the same total whether it is measured from the demand side or from the supply side, but, for reasons that will become clear, transportation appears more important when viewed from the demand side. This section discusses the importance of transportation from the demand side, and compares it with other social functions. Finally, it addresses the supply side.

Transportation-Related Final Demand in GDP

Transportation-related final demand is defined as the value of all goods and services purchased by consumers and governments for transportation purposes, plus all goods and services purchased by businesses as investments for transportation purposes. Final demand data are compiled regardless of industry origin. This means, for example, that even though automobiles are the output of the automotive industry, not the output of the transportation industry, consumer and government demand for automobiles is counted in transportation-related final demand, because automobiles are purchased for transportation purposes.

The share of transportation-related final demand in GDP measures the importance of transportation demand to the economy, and indicates how society values transportation. The share of transportation-related final demand in GDP, however, is not a correct measure of the contribution of the transportation *industry* to the economy. This is because transportation-related final demand includes not only the value of the for-hire transportation industry's output but also the value of outputs of nontransportation industries, such as cars from the automobile manufacturing industry, gasoline from the petroleum refinery industry, and automobile insurance services from the insurance industry.

The major components of GDP, from the final demand side, are consumer expenditures, government expenditures, capital investments, and exports and imports. Tables 2-1a and 2-1b present transportation-related final demand and its share in GDP in current dollars and chain-type 1992 dollars, respectively. (See box 2-1 for an explanation of chain-type indices.) In current dollars, transportation-related final demand totaled $777 billion in 1995, up 3.5 percent from 1994. At the same time, GDP grew 4.5 percent, from $6.9 trillion in 1994 to $7.2 trillion in 1995. (USDOC BEA 1996) Consequently, the share of transportation-related final demand in GDP declined slightly from 10.8 percent in 1994 to 10.7 percent in 1995.

Transportation-related final demand, however, grew faster than GDP over the longer period from 1991 to 1995. Measured in chain-type 1992 dollars, GDP grew 11 percent between 1991 and 1995, while transportation-related

[1] GDP is defined as the net output of goods and services produced by labor and property located in the United States, valued at market prices. As long as the labor and property are located in the United States, the suppliers (workers and owners) may be either U.S. residents or residents of foreign countries.

[2] As defined here, the transportation industry comprises only those establishments whose primary economic activity is to provide transportation services to the public for a fee. A more complete measure of transportation's importance from the supply side would also include the contribution of in-house transportation services within companies. As is discussed subsequently, research is underway to develop better measures of these in-house services.

Table 2-1a.
U.S. Gross Domestic Product Attributed to Transportation-Related Final Demand: 1991–95
(In billions of current dollars)

	1991	1992	1993	1994	1995
Gross domestic product	$5,916.7	$6,244.4	$6,550.2	$6,931.4	$7,245.8
Total transportation in gross domestic product	10.5%	10.7%	10.8%	10.8%	10.7%
Total transportation final demand	**623.9**	**669.4**	**708.2**	**751.2**	**777.2**
Personal consumption of transportation	**436.8**	**471.6**	**503.8**	**536.5**	**554.9**
Motor vehicles and parts	187.6	206.9	226.1	245.3	247.8
Gasoline and oil	103.9	106.6	108.1	109.9	114.6
Transportation services	145.3	158.1	169.6	181.3	192.5
Gross private domestic investment	**82.7**	**89.9**	**103.3**	**122.0**	**130.5**
Transportation structures	3.2	3.7	4.1	4.9	5.6
Transportation equipment	79.5	86.2	99.2	117.1	124.9
Net exports of goods and services	**–16.8**	**–15.5**	**–25.9**	**–38.0**	**–44.8**
Exports (+)	**115.8**	**125.0**	**125.7**	**132.7**	**133.7**
Civilian aircraft, engines, and parts	36.6	37.7	32.7	31.5	26.2
Automotive vehicles, engines, and parts	40.0	47.0	52.4	57.6	60.9
Passenger fares	15.9	16.6	16.6	17.5	18.3
Other transportation	23.3	23.7	24.0	26.1	28.3
Imports (–)	**132.6**	**140.5**	**151.6**	**170.7**	**178.5**
Civilian aircraft, engines, and parts	11.7	12.6	11.3	11.3	10.7
Automotive vehicles, engines, and parts	85.7	91.8	102.4	118.3	124.9
Passenger fares	10.0	10.6	11.3	12.7	13.4
Other transportation	25.2	25.5	26.6	28.4	29.5
Government transportation-related purchases	**121.2**	**123.4**	**127.0**	**130.7**	**136.6**
Federal purchases	16.2	16.8	17.7	19.3	21.0
State and local purchases	89.2	95.3	99.5	102.8	106.2
Defense-related purchases	15.8	11.3	9.8	8.6	9.4

NOTE: In 1996, the Bureau of Economic Analysis revised its estimates for prior years in the National Income and Product Accounts. Consequently, the numbers in table 2-1a are different from data previously reported by BTS in *Transportation Statistics Annual Report 1996*.

SOURCE: U.S. Department of Transportation, Bureau of Transportation Statistics calculations based on: U.S. Department of Commerce, Bureau of Economic Analysis. 1996. *Survey of Current Business.* Various issues.

final demand grew 14 percent in real terms. Private domestic investment in transportation was about $131 billion in 1995, or about 17 percent of all transportation-related final demand. Private domestic investment in transportation structures (e.g., rail tracks) and equipment (e.g., airplanes) grew more rapidly than transportation-related final demand as a whole. In real terms, private investment in transportation structures grew 53 percent and private investment in transportation equipment grew 44 percent between 1991 and 1995. (USDOC BEA 1996)

A nation's demand can be met by domestic production and/or imports. By the same token, a nation's production can be used to meet both domestic demand and exports. If transportation-related exports are larger than transportation-related imports, total transportation-related final demand will be greater than domestic transportation-related final demand, and vice versa. Because, in fact, the United States has a trade deficit in transportation-related goods and services, its domestic transportation-related final demand is greater than its transportation-related final demand. Between 1991 and 1995, U.S. domestic transportation-related final demand

Table 2-1b.
U.S. Gross Domestic Product Attributed to Transportation-Related Final Demand: 1991–95
(In billions of chained 1992 dollars)

	1991	1992	1993	1994	1995
Gross domestic product	$5,916.7	$6,244.4	$6,550.2	$6,931.4	$7,245.8
Total transportation in gross domestic product	10.5%	10.7%	10.8%	10.8%	10.7%
Total transportation final demand	**639.5**	**669.4**	**689.3**	**715.1**	**729.0**
Personal consumption of transportation	**448.9**	**471.6**	**490.3**	**509.9**	**511.3**
Motor vehicles and parts	193.2	206.9	218.6	228.2	221.0
Gasoline and oil	103.4	106.6	109.1	110.4	113.3
Transportation services	152.3	158.1	162.6	171.3	177.0
Gross private domestic investment	**84.9**	**89.9**	**101.4**	**116.1**	**122.9**
Transportation structures	3.2	3.7	3.9	4.4	4.9
Transportation equipment	81.7	86.2	97.5	111.7	118.0
Net exports of goods and services	**–16.7**	**–15.5**	**–26.0**	**–35.5**	**–40.1**
Exports (+)	**118.3**	**125.0**	**123.6**	**129.0**	**127.2**
Civilian aircraft, engines, and parts	37.8	37.7	31.8	29.8	24.0
Automotive vehicles, engines, and parts	40.8	47.0	51.9	56.6	59.1
Passenger fares	16.3	16.6	16.3	16.8	16.6
Other transportation	23.4	23.7	23.6	25.8	27.5
Imports (–)	**135.0**	**140.5**	**149.6**	**164.5**	**167.3**
Civilian aircraft, engines, and parts	12.0	12.6	11.0	10.7	9.8
Automotive vehicles, engines, and parts	87.2	91.8	100.7	112.6	115.6
Passenger fares	10.3	10.6	11.5	12.8	12.8
Other transportation	25.5	25.5	26.4	28.4	29.1
Government transportation-related purchases	**122.4**	**123.4**	**123.6**	**124.6**	**134.9**
Federal purchases	16.6	16.8	17.0	18.0	18.0
State and local purchases	90.0	95.3	96.9	98.2	107.8
Defense-related purchases	15.8	11.3	9.7	8.4	9.1

SOURCE: U.S. Department of Transportation, Bureau of Transportation Statistics calculations based on: U.S. Department of Commerce, Bureau of Economic Analysis. 1996. *Survey of Current Business.* Various issues.

Box 2-1.
Measuring Real Economic Growth: Chain-Type Indices

Gross domestic product (GDP) estimations consist of two phases: 1) estimating current-dollar values, and 2) separating the current-dollar values into a price-change component and a quantity-change component. Each phase contains many steps with interrelated data processes. Although measuring change in current-dollar GDP is conceptually straightforward, separating the price- and quantity-change elements is not. Because they cannot be observed directly in the economy, aggregate price and quantity changes must be estimated. In the past, changes in real GDP were calculated using fixed-weighted indices (FWI). A fixed-weighted quantities index uses the prices of a single base year to value the output in every year, and a fixed-weighted price index uses the quantities of the base year as weights to calculate a GDP price index.

A FWI has a notable disadvantage. When used for a long period, it results in a substitution bias that causes an overstatement of growth for years after the base year and an understatement for years before the base year. The bias occurs when a consumer substitutes products whose relative prices are declining for products whose relative prices are rising. Substitutions of this type are commonly made by consumers. In general, products whose quantities have increased the most are those whose prices have increased the least. Therefore, economic growth between any two years will be evaluated at relatively higher prices if the beginning year is used as a base year and hence the calculated growth rate will be higher. The opposite will be true if the end year is used as a base year.

The question is: Which calculation—the beginning year or the end year as a base year—is correct? There is no single correct answer to this question because either year's prices are equally valid for valuing the changes in quantities. A common sense approach to the weighting problem is to take an average of the two calculations. Economic theory indicates that a method of averaging called the Fisher Ideal Index, which takes into account the geometric mean of the two calculations, is a preferred form of averaging.

The Bureau of Economic Analysis recently started using the Fisher Ideal Quantity Index to calculate change between adjacent years. Annual changes are then chained (multiplied) together to form a time series.

Chain-type indices recognize the need to use weights that are appropriate for the specific periods being measured. Chain-type indices have important advantages over an FWI. First, instead of merely reflecting overall inflation, they capture the effect of relative changes in prices and in the composition of output, thereby taking into account the substitution effect. They also provide a more accurate description of cyclical fluctuations in the economy. This, in turn, will improve analyses of productivity and returns on investment. Finally, they eliminate the inconvenience and confusion of updating weights and base periods, and thus rewriting economic history every few years.

grew 17 percent from $656.2 billion to $769.1 billion in chain-type 1992 dollars, faster than both the transportation-related final demand and GDP. (USDOC BEA 1996)

In real terms, imports of transportation-related goods and services grew 24 percent between 1991 and 1995, while exports grew less than 8 percent. Consequently, the trade deficit in transportation-related goods and services, measured in chain-type 1992 dollars, swelled from $16.7 billion in 1991 to $40.1 billion in 1995. (USDOC BEA 1996)

Transportation and Other Major Social Functions

Transportation-related final demand in GDP can be compared with demand for other socioeconomic activities. Because production is only the means and consumption is the end, the general public may understand the importance of a socioeconomic activity better from a consumption perspective rather than from a production perspective. For example, when asked about food, consumers are more likely to think about how much they spend on food, not how much food is produced. Similarly, transportation-related final demand shows how much the American people, governments, and businesses spend for the purpose of transportation.

In order to compare transportation with other major socioeconomic activities, GDP can be divided into six major social functions: food, housing, transportation, health care, education, and other. Their values and shares in GDP are presented in table 2-2, which shows that housing is the largest social function in the American society. Health care ranks second, followed by food, transportation, and education.

Between 1991 and 1995, the economy grew 22 percent in current dollars. Transportation, housing, health care, and education grew faster than GDP, while food and "other" grew more slowly. Among the functions, health care grew the fastest—33 percent between 1991 and 1995. Housing was second, increasing by 29 percent, transportation-related final demand was third, at 25 percent, and education was fourth, at 24 percent. Demand for food grew by only 18 percent, less than GDP growth in the same period. Consequently, the shares of health care, housing, and transportation in GDP increased between 1991 and 1995, while the shares of food and "other" decreased. Education shares remained essentially level during this period. (USDOC BEA 1996) These changes reflect a general trend in economic development. As income increases, people's demands shift away from basic needs to services that improve the quality of their life, such as health care and personalized transportation.

For-Hire Transportation Industry

Just as transportation as a social function uses goods and services from many industries in the economy, the for-hire transportation industry provides transportation services throughout the economy and society. The aggregate measure of its importance is transportation value-added, which is the share of GDP contributed by the for-hire transportation industry.

The for-hire transportation industry adds value when it provides products and services to other industries, governments, and consumers. For example, coal increases in value when it is transported from the site where it is mined to a

Table 2-2.
U.S. Gross Domestic Product by Social Function: 1991 and 1995
(In billions of current dollars)

	1991		1995	
	Amount	Percentage of GDP	Amount	Percentage of GDP
Total GDP	5,916.7	100.0	7,245.8	100.0
Housing	1,371.0	23.2	1,762.9	24.3
Health	804.4	13.6	1,067.70	14.7
Food	779.1	13.2	915.9	12.6
Transportation	623.9	10.5	777.2	10.7
Education	407.8	6.9	503.9	7.0
Other	1,930.5	32.6	2,218.1	30.6

KEY: GDP = gross domestic product.

NOTE: Percentages do not add due to rounding.

SOURCE: U.S. Department of Transportation, Bureau of Transportation Statistics calculations based on: U.S. Department of Commerce, Bureau of Economic Analysis. 1996. *Survey of Current Business.* Various issues.

powerplant where it is used to produce electricity. The value an industry adds is the net output of that industry. Because value-added from all industries sums up to GDP, the share of the value-added originating in an industry measures the contribution of that industry to the economy.

For-hire transportation GDP reached $222.8 billion (current dollars) in 1994, larger than that of agriculture, mining, communications, public utilities, and education, but smaller than that of construction, manufacturing, and health care. (USDOC BEA 1996) In 1994, for-hire transportation accounted for 3.2 percent of total GDP in current dollars and 3.3 percent in constant dollars.

The GDP contribution varies enormously among the seven for-hire transportation subindustries, and in 1994 ranged from $95.1 billion for trucking and warehousing to $5.7 billion for pipelines (current dollars) (see table 2-3). The shares of the various modes were stable from the late 1980s to the 1990s, with trucking and warehousing accounting for about 43 percent of transportation GDP at the high end and pipelines accounting for about 3 percent at the low end (see figure 2-1). The modal distribution, however, has changed dramatically since 1959, the earliest year for which data are available. In that year, the railroad industry accounted for 38.3 percent of total transportation GDP. In 1994, it accounted for only 10.9 percent. During this same period, the share of trucking and warehousing went up from 31.7 to 42.7 percent. The biggest gain was the air transportation industry. Its share in total transportation GDP nearly tripled from 7.9 percent in 1959 to 22.9 percent in 1994.

It is important to understand that the current national account statistics cited above include only those establishments that provide transportation services on a for-hire basis.[3] The national account does not presently allow accurate estimation of the contribution of establishments that

[3] The national account is a comprehensive and detailed record of U.S. economic activities and interactions between sectors of the economy. The Bureau of Economic Analysis created this database using Census Bureau information.

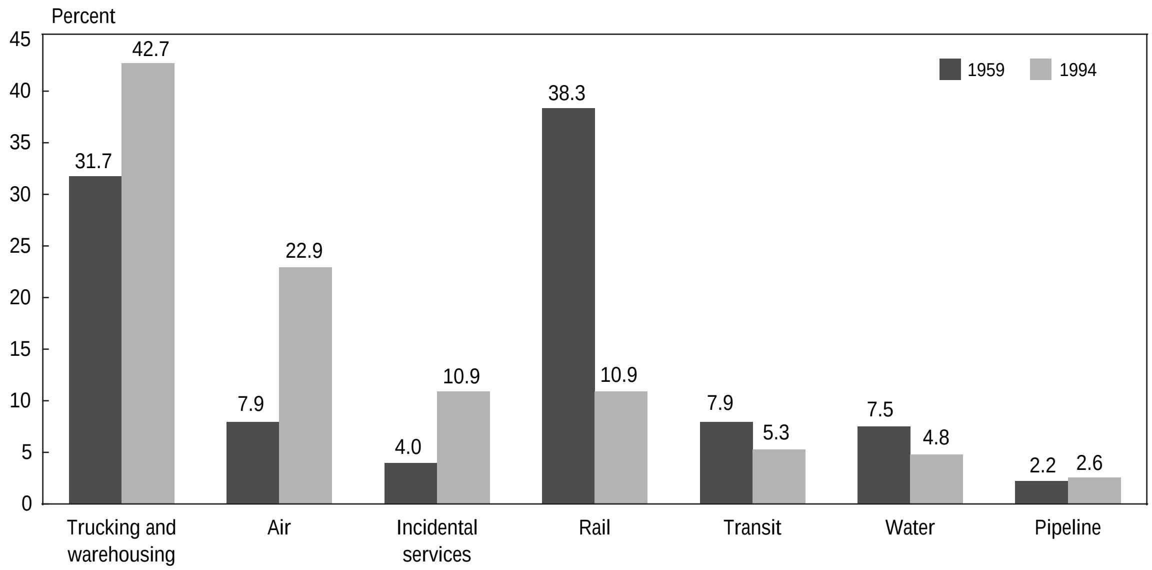
Table 2-3.
U.S. Gross Domestic Product Attributed to For-Hire Transportation: 1990–94
(In billions)

	Current dollars					Chained 1992 dollars				
	1990	**1991**	**1992**	**1993**	**1994**	**1990**	**1991**	**1992**	**1993**	**1994**
Total	$176.4	$185.8	$192.8	$207.6	$222.8	$176.7	$185.5	$192.8	$205.1	$215.5
Trucking and warehousing	75.8	77.9	82.2	88.4	95.1	73.7	78.5	82.2	88.3	89.6
Air	39.4	40.8	43.0	48.6	51.1	39.5	39.4	43.0	45.2	49.9
Railroad	19.6	21.9	22.1	23.0	24.3	18.7	21.7	22.1	24.0	26.2
Incidental services	17.8	19.4	19.6	20.8	24.3	19.2	19.2	19.6	20.8	21.9
Transit	9.0	10.2	10.9	11.3	11.7	10.3	10.5	10.9	10.9	11.1
Water	9.7	10.7	10.3	10.3	10.6	10.7	11.1	10.3	10.4	10.9
Pipeline	5.0	5.0	4.9	5.2	5.7	4.8	5.2	4.9	5.7	6.0

NOTE: Numbers may not add due to rounding.

SOURCE: U.S. Department of Commerce, Bureau of Economic Analysis. 1996. *Survey of Current Business.* August.

Figure 2-1.
Change in the Modal Share of For-Hire Transportation: 1959 and 1994



NOTE: Calculated from the gross domestic product attributed to for-hire transportation.

SOURCE: U.S. Department of Commerce, Bureau of Economic Analysis. 1996. *Survey of Current Business.* August.

provide transportation services to their owner companies, so-called in-house transportation. Were in-house transportation included, the transportation industry's share of GDP would be larger. The U.S. Transportation Satellite Account (a joint project of the Bureau of Transportation Statistics (BTS) and the U.S. Department of Commerce, Bureau of Economic Analysis), will provide a more complete picture of in-house transportation when the project is completed.

Consumer Expenditures for Transportation

This section discusses consumer expenditures in the United States, using data from the Department of Labor, Consumer Expenditure Survey. How much people pay for transportation, as determined by such surveys, is one of the better indicators of the importance of transportation to society. Expenditures reflect people's preferences and incomes as well as available goods and services. As these factors change, the pattern of consumer expenditures also will change. See chapter 7 for a discussion of household income and mobility trends among socioeconomic and demographic groups.

Between 1984 and 1994, American household spending, on average, increased from $21,975 to $31,751 (in current dollars), growing 3.7 percent annually. The proportion of expenditures on housing, health care, and insurance and pensions went up, while the share of food and apparel went down. The share of transportation in household expenditures reached its peak at 20.3 percent in 1986. Thereafter, it declined and reached its low of 17.4 percent in 1991. From 1991 to 1994, it rose again so that transportation averaged 19 percent of household spending in 1994, following housing at 31.8 percent.

Transportation expenditures by households grew at an average annual rate of 3.5 percent between 1984 and 1994, measured in current dollars (see table 2-4). This growth rate was slightly lower than the growth rate for total household expenditures. While expenditures on all other transportation items increased, household spending on gasoline and motor oil fell from an average of $1,058 in 1984 to $986 in 1994 (again, in current dollars). (USDOL BLS 1984–94) This is a 6.8 percent decrease, even without considering inflation. The decline in household spending on gasoline and motor oil reflects lower fuel prices and greater vehicle fuel efficiency. (USDOL BLS 1984–94) BTS analysis shows that the increase in vehicle fuel efficiency contributed two-thirds and the fall in fuel prices contributed one-third to the reduction in household expenditures on transportation between 1984 and 1994. As the figures for average household expenditures on gasoline, vehicle-miles traveled, vehicle fuel efficiencies, and gasoline prices come from different sources and are based on different assumptions and samples, they may not be comparable.

Table 2-4.
Household Expenditures on Transportation: 1984 and 1994

Type of expenditure	1984	1994
Average annual household tranportation expenditures (in current dollars)	$4,304	$6,044
Percentage of components of transportation expenditures:		
Vehicle purchases	**42.1**	**45.1**
Cars and trucks, new	23.9	23.0
Cars and trucks, used	17.6	21.3
Other vehicles	0.6	0.7
Gasoline and motor oil	**24.6**	**16.3**
Other vehicle expenses	**27.4**	**32.3**
Vehicle finance charges	4.9	3.9
Maintenance and repairs	11.2	11.3
Vehicle insurance	8.1	11.4
Vehicle rental, licenses, other charges	3.1	5.7
Purchased transportation service	**5.9**	**6.3**

SOURCE: U.S. Department of Labor, Bureau of Labor Statistics. 1984–1994. Consumer Expenditure Survey.

Vehicle finance charges constitute a household expenditure that grew much more slowly than the total. On average, these charges increased from $213 in 1984 to $235 in 1994. (USDOL BLS 1984–94) This slower increase is due to falling interest rates, and low or even zero interest rates offered by car manufacturers as an incentive to purchase vehicles. (This may indicate a switch in category, as producers substituted low interest charges for price rebates.)

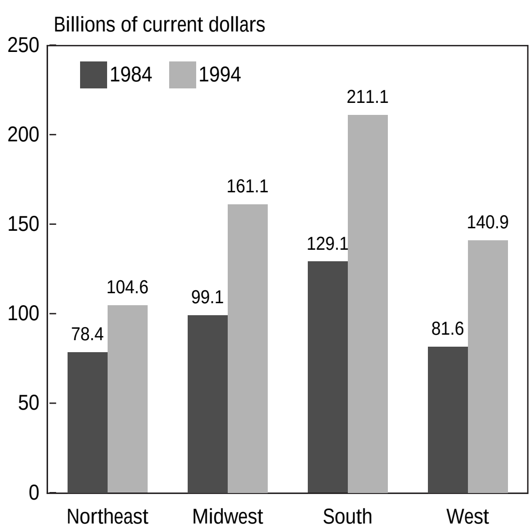
In contrast, the average household expenditure on vehicle insurance doubled from $349 in 1984 to $690 in 1994. Household expenditures on vehicle rental, licenses, and other charges also increased greatly from 1984 to 1994. Another growing item on the household shopping list was used cars and trucks. (USDOL BLS 1984–94) Two factors may have caused this change. First, the expected useful life of new cars has increased, which in turn increases the remaining life of used cars on the market. In 1993, the average automobile in use was 8.3 years old, compared with 7.5 years in 1984. Interestingly, despite this increase in average age, the data in table 2-4 show very little change in the expenditure share for vehicle maintenance and repair—11.2 percent in 1984 and 11.3 percent in 1994 (with both higher and lower figures in the intervening years). Second, the average price of new cars has risen faster than the average income of American households, which may account for a larger proportion of households buying used rather than new cars. Between 1984 and 1993, the average price of a new car rose 60 percent from $11,450 to $18,328, while average household income after taxes rose 50 percent from $21,237 to $31,890. (Davis and McFarlin 1996, table 3.5 for age of automobiles in use; table 2.3 for price of a new car)

Regional Differences

American households spent $618 billion on transportation-related goods and services in 1994, up 59 percent from $388 billion in 1984 (expressed in current dollars). (USDOL BLS 1984–94) The regional distribution of household transportation expenditures is presented in figure 2-2. A region's share of household transportation expenditures depends on its share of households, and on how much households in that region spend on transportation compared with households in other regions.

In 1994, total household transportation expenditures were about 17 percent for the Northeast, 26 percent for the Midwest, 34 percent for the South, and 23 percent for the West.

Figure 2-2.
Household Transportation Expenditures by Region: 1984 and 1994



SOURCE: U.S. Department of Labor, Bureau of Labor Statistics. 1984–94. Consumer Expenditure Survey.

Between 1984 and 1994, only the Northeast region's share of total household transportation expenditures declined, while the other three regions' share rose.

A relatively slow increase in annual transportation expenditures per household in the Northeast contributed to the region's declining share. From 1984 to 1994, average yearly household transportation expenditures in the Northeast increased 28 percent, but the increase was 48 percent in midwestern households, 42 percent in the South, and 37 percent in the West. More relative use of mass transit for personal travel contributed to the fall in transportation's share of household spending in the Northeast. In 1994, northeastern households spent, on average, $123 on intracity mass transit, higher than the other three regions, and more than two and a half times the national average.

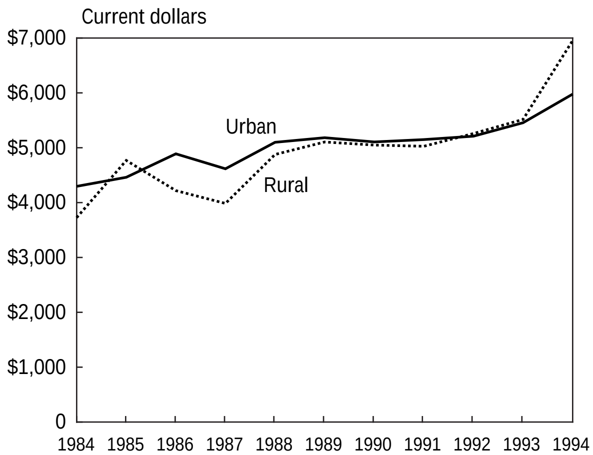
Rising shares of total household transportation expenditures for the South and West reflect their increasing proportion of the total population. The faster increase in annual household transportation expenditures in the Midwest, on the other hand, offset the effect of the region's population decline. As a result, the Midwest region's share of total household transportation expenditures increased, rather than decreased.

Rural and Urban Expenditures

In 1994, rural household spending on transportation was $6,807, or 115 percent of urban spending ($5,919). In 1984, however, average rural household spending on transportation was 88 percent of urban spending (see figure 2-3).

The major factor behind the relative surge of transportation expenditures by rural households was increased spending on vehicles. In 1984, average rural spending on vehicles was $1,577, or 85 percent of the average urban household expenditure on vehicles ($1,860). Between 1984 and 1994, average urban household expendi-

Figure 2-3.
Urban and Rural Household Transportation Expenditures: 1984–94



SOURCE: U.S. Department of Labor, Bureau of Labor Statistics. 1984–1994. Consumer Expenditure Survey.

tures on vehicles grew 39 percent, compared with the 128 percent increase for rural households. One explanation for the difference is that rural residents depend almost completely on household-owned vehicles, while urban residents' demand for transportation is partially met by transit. In 1994, rural households spent on average $3,601 to buy vehicles, 40 percent more than urban households ($2,581). (USDOL BLS 1984–94)

Expenditures by Sex of Household Head

On average, male-headed households spend more on transportation than female-headed households, both in dollars and in percentage of total household expenditures. Between 1988 and 1994, however, the share of transportation expenditures increased in households headed by females, while the share in households headed by males decreased. In the 1988–89 survey year, male-headed households devoted 19.9 percent of their total spending to transportation, while female-headed households spent only 13.9 percent. By the 1993–94 survey year, the share for male-headed households dropped to 18.9 percent, and the share for female-headed households rose slightly to 14.1 percent. Moreover, the income gap between male- and female-headed households decreased. In 1994, the average income for households headed by males ($23,525) was 1.34 times the average income for households headed by females ($17,519). (USDOL BLS 1984–94)

Female-headed households spend less on vehicles, both absolutely and proportionally, than do male-headed households. In the 1988–89 survey year, male-headed households spent, on average, 42 percent of their transportation dollars on vehicles, while female-headed households spent only 36 percent. Between 1989 and 1994, however, female-headed households increased their spending on vehicles faster than they did on transportation as a whole. As a result, by the 1993–94 survey year, female-headed households spent 38 percent of their transportation budget on vehicles, while male-headed households remained at 42 percent.

Although female-headed households spend less on vehicles than do male-headed households, they spend proportionally more on new vehicles and vehicle insurance. In the 1993–94 survey year, new vehicle expenditures, on average, accounted for 19 percent of male-headed household transportation expenditures, but more than 25 percent of female-headed household transportation outlays. In the same year, vehicle insurance accounted for 11 percent of male-headed household transportation spending, but 15 percent for female-headed households.

Transportation Employment

Employment is another important indicator of transportation's contribution to the economy. This section discusses three overlapping, but conceptually different, measures that may be used to calculate transportation employment: 1) employment in the for-hire transportation industry; 2) employment by transportation function; and 3) employment by transportation occupation. Each is useful, but each has significant weaknesses. Because statistical coverage of the for-hire transportation industry is extensive, employment in this industry (counted as full-time equivalent workers) is most often used as the measure of transportation employment. Transportation functions, however, are performed not only by employees of for-hire transportation industries, but also by employees of all nontransportation industries that have their own in-house transportation operations. Ideally, employment by transportation function, the second category, would include all persons working in transportation operations, regardless of industry or position. In-house transportation, however, is not well covered in current statistics, so complete data on employment by transportation function are not readily available. The third category, employment by transportation occupation, covers every industry, but includes only people with skills specific to transportation, such as truck drivers and aircraft pilots. There is an employment measure for each transportation occupation, however, persons with general skills who apply those skills to transportation endeavors are not counted as being employed in transportation occupations.

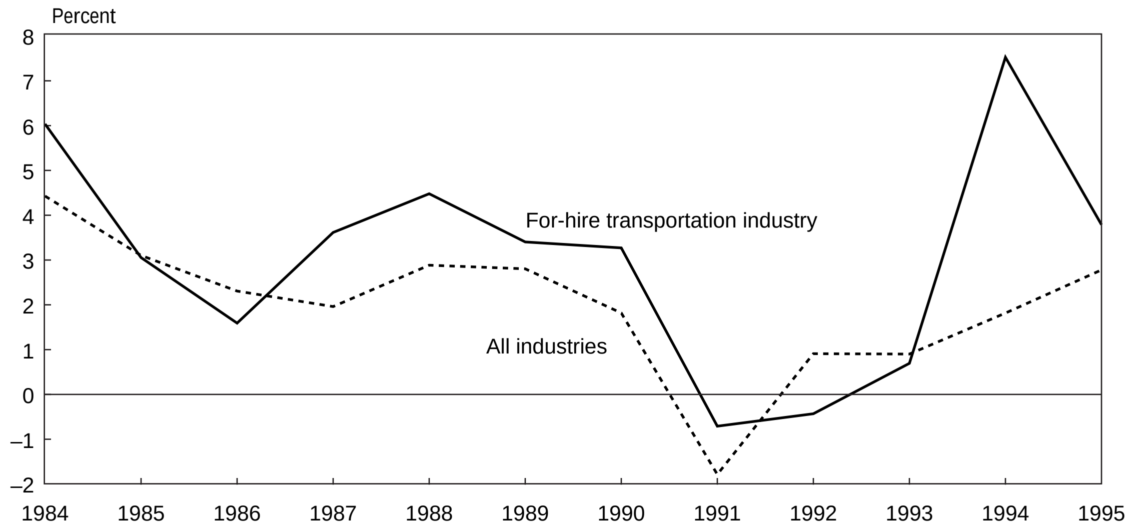
Because these three measures all yield different employment figures, they could provide useful information on transportation employment from different perspectives and could be used for different analytical purposes. For example, data on employment in the trucking industry tells us how many people work in the for-hire trucking industry, which includes truck drivers, managers, clerks, and other support staff. Employment by trucking occupation tells us how many people work as truck drivers, regardless of industry. Employment by trucking function tells us how many people work in trucking and trucking support activities throughout the economy, for example, including mechanics and dispatchers. Conceptually, employment by function covers all people working in the for-hire trucking industry and all employment by trucking purpose in every other industry. Still, because such comprehensive data are not available on employment by transportation function, the following discussion of data on transportation employment will focus on figures for industry and occupational employment.

Employment in the For-Hire Transportation Industry

The for-hire transportation industry employed nearly 3.9 million workers in 1995. (USDOL BLS 1996) For most of the 1980s and 1990s, employment in the transportation industry either grew at a higher rate or declined less in a recessionary period, such as 1991, than total national employment. The exceptions occurred in 1986, 1992, and 1993 (see figure 2-4). Transportation employment growth resumed in 1994 and 1995.

The growth pattern differs significantly between the seven transportation modes for which there are data. In 1994—the year of highest growth for transportation employment as a whole—trucking, transit, and transportation services had double-digit increases from the previous year, while the railroad and pipeline industries experienced employment losses. (USDOL BLS 1996) Table 2-5 shows the modal structure of transportation employment in 1983 and 1995. The railroad industry lost employment share over the period, although that trend was set long before 1983. During these 13 years, the railroad industry's employment share fell by more than half, from 14 percent in 1983 to 6 percent in 1995. Water and pipeline shares also decreased.

Figure 2-4.
Annual Rate of Employment Growth: 1984–95



SOURCES: U.S. Department of Labor, Bureau of Labor Statistics, Office of Employment Projections. 1994. The National Industry-Occupation Employment Matrix, 1983–1993 Time Series. July.
U.S. Department of Labor, Bureau of Labor Statistics. 1995 and 1996. *Monthly Labor Review.* June

In contrast, trucking, air, transit, and transportation services increased their modal shares. Trucking's employment share rose slightly from 45 percent in 1983 to 48 percent in 1995, a net increase of more than 644,000 workers, almost equal to the combined workforce of the railroad and transit industries in 1995. Over the same period, the air industry's share rose from 17 percent to 20 percent. (USDOL BLS 1996)

Employment in Transportation Occupations

Almost all nontransportation industries in the United States have some in-house transportation operations. For example, a grocery store chain may have its own trucking operations and warehouses; a manufacturing company may have its own rail freight cars; many firms have their own fleets of company automobiles or their own general aviation aircraft, with employees to manage these functions. In-house transportation operations are not separated from their parent activities in the national accounts data and employment statistics. Thus, the numbers for an

Table 2-5.
Employment in For-Hire Transportation by Mode: 1983–95
(In percent)

Mode	1983	1995
Trucking	44.5	47.6
Air	16.6	20.1
Transit	9.3	10.8
Services	8.3	10.5
Railroad	13.7	6.1
Water	6.9	4.4
Pipeline	0.7	0.4

SOURCES: (1) U.S. Department of Labor, Bureau of Labor Statistics, Office of Employment Projections. 1994. The National Industry-Occupational Employment Matrix, 1983-93 Time Series. July.
(2) U.S. Department of Labor, Bureau of Labor Statistics. 1995 and 1996. *Monthly Labor Review, Employment and Earnings.* June.

industry always include some transportation-related employment. Because there are no data on transportation-related employment in non-transportation industries, employment estimates by occupation are used to arrive at the total number of people working in a transportation function.

Operating on the principle that occupations are grouped by functions and skills, the Occupational Employment Statistics (OES) system of the Bureau of Labor Statistics (BLS) classifies workers into seven divisions: 1) managerial and administrative; 2) professional, paraprofessional, and technical; 3) sales and related areas; 4) clerical and administrative support; 5) service; 6) agriculture, forestry, fishing, and related areas; and 7) production, construction, operations, maintenance, and material handling. Transportation and materials handling is 1 of 10 major groups within the last division. At the most detailed level, there are 13 transportation occupations classified and covered in the OES system.

In 1993, the latest year for which detailed occupational data are available, 3.5 million people worked in various transportation occupations[4] (see table 2-6). The largest occupational category was truck drivers, 63 percent of the total. The next largest group was bus drivers, who accounted for 16 percent. The combined total for the six railroad transportation occupations was 3.3 percent of the transportation total, only slightly larger than taxi drivers and chauf-

[4] This does not include 1.3 million workers in material-moving occupations. If these workers are included, the number of people employed in transportation occupations would total 4.8 million.

Table 2-6.
Employment in Selected Transportation Occupations: 1985 and 1993
(In thousands)

Standard occupational code	Occupations	1985	1993
NA	Total U.S. civilian employment	99,700.0	112,000.0
NA	Total in selected transportation occupations	3,055.4	3,492.3
97001	Truck drivers, light and heavy trucks	1,967.9	2,196.3
97110	Bus drivers	456.6	567.0
97198	All other motor vehicle operators	291.8	342.6
97300	Rail vehicle operators[1]	126.2	115.3
68026	Flight attendants	73.1	93.3
97702	Air flight pilots and flight engineers	66.5	82.8
97114	Taxi drivers and chauffeurs	47.2	72.4
39002	Air traffic controllers	26.1	22.6

[1] Rail vehicle operators include:

97302	Railroad conductors and yardmasters	97310	All other rail vehicle operators
97305	Locomotive engineers	97314	Subway and streetcar operators
97308	Railyard engineers, dinkey operators, and hostlers	97317	Railroad brake, signal, and switch operators

KEY: NA = not applicable.

NOTE: Cited employment numbers are from an establishment-based survey and differ from those found in the Census Bureau's household-based Current Population Survey.

SOURCE: U.S. Department of Labor, Bureau of Labor Statistics, Office of Employment Projections. 1994. The National Industry-Occupation Employment Matrix, 1983–93 Time Series. July.

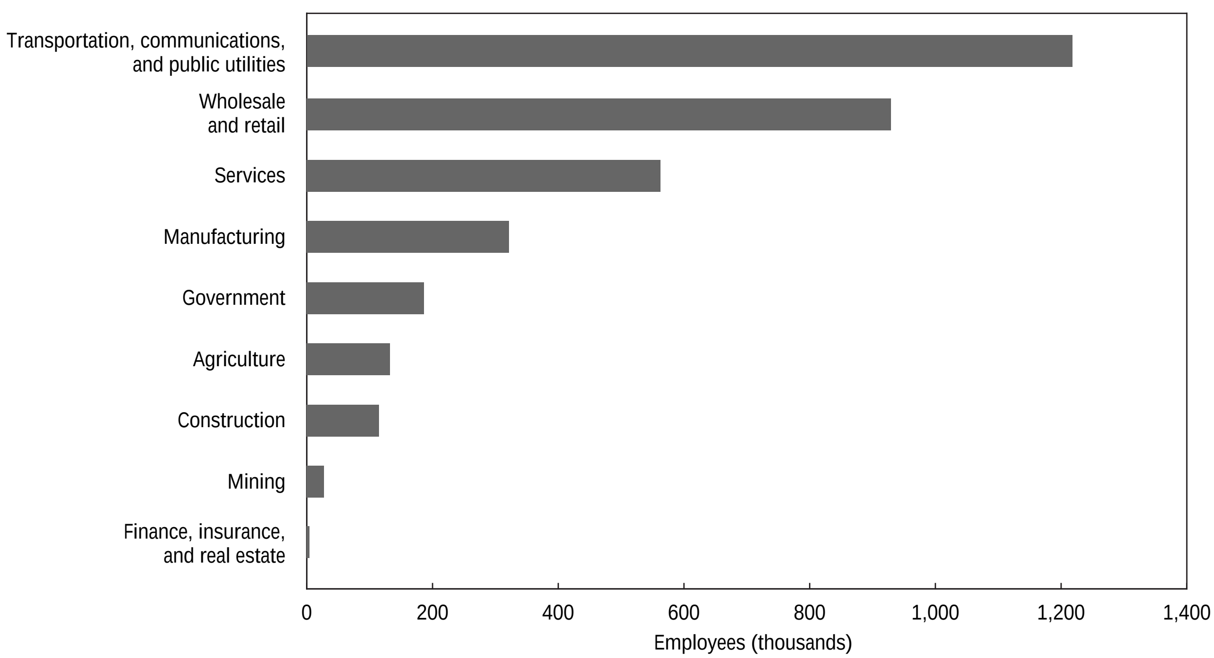
feurs (2 percent). Air flight occupations accounted for 5.7 percent of the total.

The distribution of transportation jobs across industries depends on the occupation. For example, flight attendants are found in only one industry—air transportation, but every industry employs some truck drivers. Not surprisingly, the nontransportation industry with the largest number of transportation jobs is wholesale/ retail, accounting for 27 percent of total transportation jobs in 1993 (see figure 2-5). Most workers in transportation occupations are employed in nontransportation industries, not in transportation industries (65 percent versus 34 percent).

Combining employment in the transportation industry and by transportation occupation outside the transportation industry provides a low-end estimate of the number of people working in transportation functions in the entire economy. In 1993, about 5.8 million people worked in transportation functions. This included 3.5 million working in for-hire transportation industries and 2.3 million in transportation occupations in nontransportation industries. People employed in for-hire transportation industries include both transportation occupations and supporting occupations, such as managers and clerks. (USDOL BLS OEP 1994)

It is worth emphasizing that the 5.8 million figure does not include those people who work in the transportation part of nontransportation industries and are in positions that are not defined as one of the transportation occupations. For example, a bookkeeper or a material mover might work full time in a manufacturing firm's transportation function, but not be included in the 5.8 million. Nor are those included who drive extensively in order to conduct business:

Figure 2-5.
Number of Employees in Transportation Occupations by Major Industry: 1993



SOURCE: U.S. Department of Labor, Bureau of Labor Statistics, Office of Employment Projections. 1994. The National Industry-Occupation Employment Matrix, 1983–1993 Time Series. July.

for example, insurance agents who drive a company car. The 1990 Census of Population recorded 137,400 driver-sales workers throughout the economy.

Not every transportation-related occupation is identified in the OES system. For example, ship captains, mates, sailors, and dockhands are not identified separately. None of these 167,400 workers would have been counted as a transportation worker. It should be clear from these examples that the real level of employment by transportation function is higher than the estimates.

For comparison purposes, the Bureau of Transportation Statistics report, *National Transportation Statistics 1997*, showed nearly 10 million people employed in transportation industries, transportation equipment manufacturing industries, and other related industries, such as highway and street construction, and federal, state, and local governments in 1993.

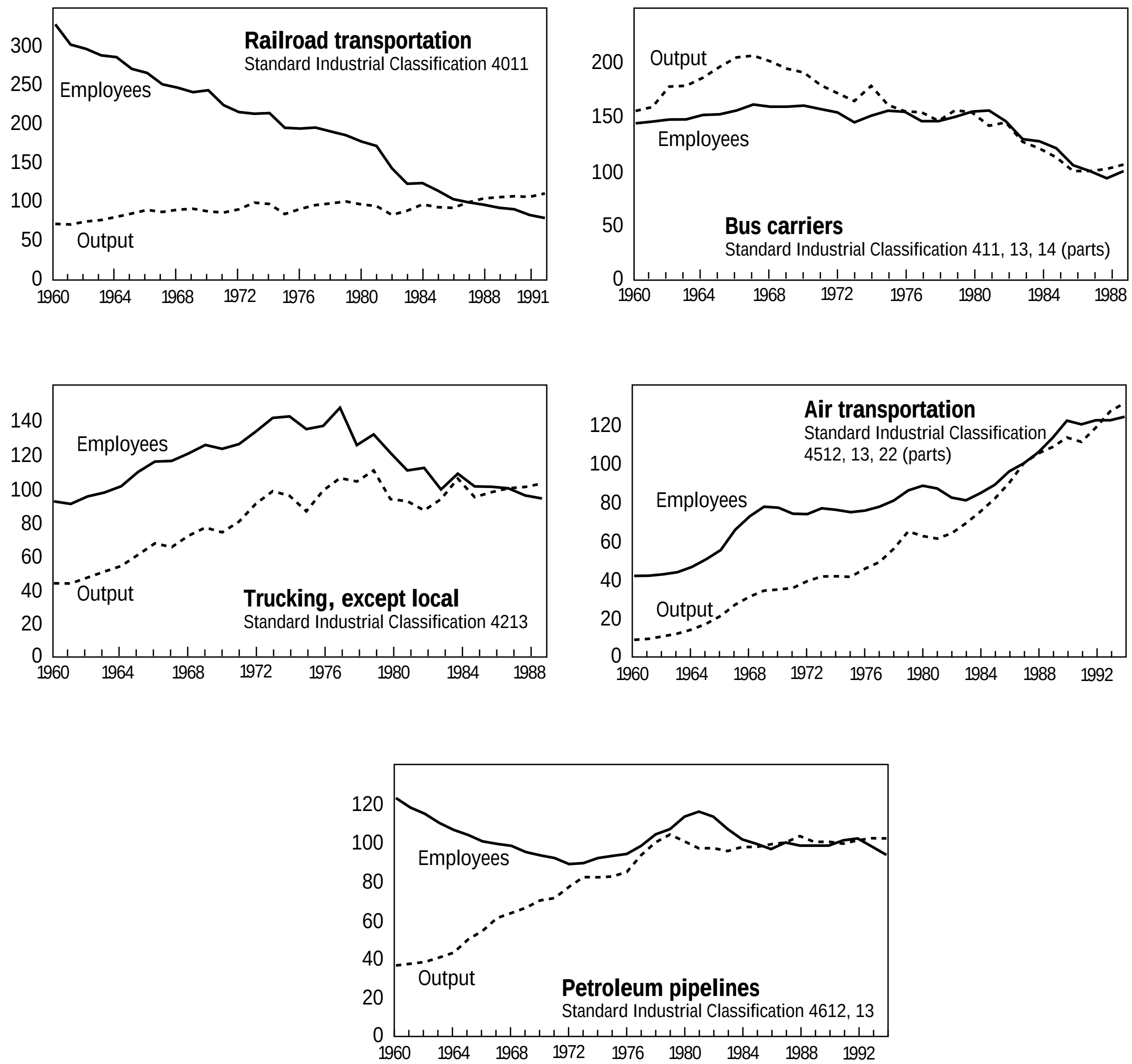
Labor Productivity in the Transportation Industry

It is difficult to draw a complete picture of transportation employment from employment data alone. For example, transportation creates millions of jobs, but employment data do not provide information about productivity. Labor productivity measures provide this information on an industry basis, not by occupation. Labor productivity measures relate output to labor input—they report on how productively people work. It is important to note that changes in labor productivity are also driven by factors other than labor, such as capital. Labor productivity can be calculated on a per-employee basis or on a per-employee-hour basis. A per-employee-based measure shows how much a typical worker produces within a certain period of time, usually a year. A per-employee-hour-based measure shows how much a worker produces within a typical working hour. This latter measure is more informative if many people work part time or overtime. (For more information on how labor productivity is measured, see USDOT BTS 1995, chapter 6.)

BLS publishes productivity measures for all transportation modes except water. Some of these measures are based on per-employee and per-employee-hour data and some on one of the two. Data for bus carriers and intercity trucking extend only to 1989, and updated data on railroads are available through 1992. Data on air transportation and petroleum pipelines are available through 1994.

Labor productivity in air transportation is calculated only on a per-employee basis. This measure gained 1.8 percent in 1994, much less than in 1993 when it increased 7.1 percent. This was caused by slow growth in *output* (7.1 percent in 1993 v. 3.4 percent in 1994) and faster growth in *employment* (no growth in 1993 v. 1.5 percent growth in 1994). Labor productivity in petroleum pipelines increased 0.7 percent in 1994 from the previous year on a per-employee-hour basis. On a per-employee basis it increased much faster, 4.5 percent. Both were caused by decreasing output and an even faster decreasing labor input. The values of the two measures are so different because the number of employees decreased much faster than the number of employee-hours in the industry (4.4 percent v. 0.7 percent). The smaller decrease in employee-hours means that pipeline workers worked longer hours. A closer look at the data shows that mostly nonsupervisory employees worked longer hours. For other modes of transportation there are no additional data available except for the revisions made by BLS. Figure 2-6 shows revised BLS data for various modes.

Figure 2-6.
Labor Productivity by Mode (Index 1987 = 100)



SOURCE: U.S. Department of Labor, Bureau of Labor Statistics, Office of Productivity and Technology. 1996. Informational material.

It is interesting to compare long-term productivity growth in transportation with that in the overall economy (see table 2-7). Over the span of nearly four decades, except for bus carriers, labor productivity growth in the transportation industries was higher than that in the overall business sector.

Table 2-7.
Annual Growth in Labor Productivity

	Growth rate	Period covered
All businesses[1]	2.0%	1959–94
Air transportation	4.6	1959–94
Petroleum pipelines	3.8	1959–94
Railroad transportation	5.9	1959–92
Trucking	2.8	1954–89
Bus carriers	0.2	1954–89

[1] Excludes farming.

SOURCE: U.S. Department of Labor, Bureau of Labor Statistics, Office of Productivity and Technology. 1996. Informational material. May.

Government Revenues and Expenditures on Transportation

Federal, state, and local governments spend considerable sums on the nation's transportation system. They build, maintain, and regulate roads, airports, mass transit facilities, ports and waterways, railroads, and pipelines. Governments pay for these services through transportation user taxes and fees. State and local governments also rely on grants from the federal government. When total revenues from these sources are less than expenditures (i.e., coverage is less than 100 percent), governments tap general tax revenues.

Revenues

Government transportation-related revenues totaled $85 billion, covering 73 percent of government transportation expenditures in fiscal year (FY) 1993. State governments collected approximately half of all transportation-related revenues, the federal government collected about

Table 2-8.
Government Transportation Revenues and Expenditures Before Transfers: Fiscal Years 1983 and 1993
(In millions)

	Current dollars		Constant 1987 dollars		Percentage growth
	1983	1993	1983	1993	1983–93
Revenue					
Total	40,029	85,034	46,047	68,883	49.6
Federal	12,507	27,311	13,744	21,954	59.7
State	19,806	41,428	23,247	33,681	44.9
Local	7,716	16,295	9,056	13,248	46.3
Expenditures					
Total	63,136	116,012	72,363	93,983	29.9
Federal	23,262	36,670	25,563	29,477	15.3
State and local	39,874	79,342	46,800	64,506	37.8

NOTE: A 2.5¢ per gallon federal motor fuel tax for deficit reduction put in effect in December 1990 has contributed to the fast increase in federal revenues. These revenues are not available for transportation expenditures, which grew much more slowly.

SOURCE: U.S. Department of Transportation, Bureau of Transportation Statistics. 1997. *Federal, State, and Local Transportation Financial Statistics, Fiscal Years 1982–94.* Washington, DC.

one-third, and local governments about one-fifth (see table 2-8). By mode, about 70 percent of government transportation revenues were generated from highway use, 15 percent from air, 10 percent from transit, and 4 percent from water.[5] (USDOT BTS 1996)

In real terms, total transportation-related revenues increased by 50 percent from FY 1983 to FY 1993, with federal revenues increasing faster than state or local government revenues. Air transportation revenues increased the fastest (73 percent), followed by water (63 percent), highway (46 percent), and transit (43 percent).[6] (USDOT BTS 1996)

At all levels of government, but particularly at the federal level, transportation-related revenues increased faster than expenditures from FY 1983 to FY 1993, increasing overall coverage from 63 percent to 73 percent; federal coverage jumped from 54 percent to 74 percent. Coverage for state and local governments increased slightly. At all levels of government, coverage was very high for highways in FY 1993. For most modes, there were substantial changes in coverage between FY 1983 and FY 1993 (see table 2-9).

Table 2-9.
Transportation Expenditures Covered by Transportation-Generated Revenues: Fiscal Years 1983 and 1993
(In percent)

	Federal government		State and local government	
Mode	**1983**	**1993**	**1983**	**1993**
Highways	81	93	75	84
Air	67	61	99	90
Water	15	41	68	79
Transit	13	78	41	32
Pipeline	U	U	NA	NA

KEY: U = data are not available; NA = not applicable.

SOURCE: U.S. Department of Transportation, Bureau of Transportation Statistics. 1997. *Federal, State, and Local Transportation Financial Statistics: Fiscal Years 1982–94.* Washington, DC.

Expenditures

In FY 1993, federal, state, and local governments spent $116 billion on transportation in current dollars, an increase of 30 percent *after* inflation from the FY 1983 level (see table 2-8). During this period, state and local government spending on transportation (before federal government transfers) increased much faster than did spending by the federal government. As a result, transportation spending by state and local governments as a proportion of all public sector transportation spending increased from 63 to 68 percent. After transfers from the federal government in the form of programs and project grants, state and local spending was approximately 88 percent of all transportation-related spending by governments in FY 1993, about the same as in FY 1983.

Most government transportation spending goes to highways—60 percent in FY 1993, unchanged from FY 1983. Air transportation and pipelines are the only modes whose shares of government spending increased during this period, from 10 percent in FY 1983 to 15 percent in FY 1993, and from 0.02 percent to 0.03 percent, respectively. The shares of water and rail declined (from 7 percent to 5 percent and from 2 percent to 0.7 percent, respectively) and transit remained almost constant (20 percent in FY 1983 to 19 percent in FY 1993). (USDOT BTS 1996)

[5] The two largest sources of federal revenues are the Highway Trust Fund (HTF), which has highway and transit accounts, and the Airport and Airway Trust Fund. The distribution assumes that HTF revenues generated by transit are credited to the transit account.

[6] In this chapter, the data on revenues collected from highway users differ from data reported in the Federal Highway Administration's (FHWA) *Highway Statistics*, table HF10. The difference is partly attributable to various data sources and BTS inclusion of items, such as vehicle operator license taxes and local parking charges, excluded by FHWA.

Table 2-10.
Government Investment in Infrastructure and Equipment After Transfers: Fiscal Years 1983 and 1993

	All government		Federal		State and local	
	1983	1993	1983	1993	1983	1993
	Current dollars in billions					
Total capital outlays	148.7	228.4	80.7	90.7	68.0	137.8
Total construction	62.1	116.3	8.8	11.4	53.3	105.0
Capital outlays on transportation	25.4	52.5	1.1	2.2	24.4	50.3
Construction in transportation	21.3	44.0	0.8	1.1	20.6	43.0
	Constant 1992 dollars in billions					
Total capital outlays	199.6	223.3	106.0	88.4	92.9	135.0
Total construction	83.4	113.7	11.6	11.1	72.8	102.8
Capital outlays on transportation	34.1	51.3	1.4	2.1	33.3	49.3
Construction in transportation	28.6	43.0	1.1	1.1	28.1	41.9

SOURCES: (1) U.S. Department of Commerce, Bureau of the Census. 1984. *Governmental Finances 1982–83*. Washington, DC.
(2) U.S. Department of Commerce, Bureau of the Census. 1996. *Government Finances: 1992–93*. [cited 23 December 1996] Available at http://www.census.gov.

Investment

This section focuses on government fixed investment in transportation, an important subject for which limited data are available. The Census Bureau defines capital outlays for government fixed investment as direct expenditures primarily for construction of buildings, roads, and other improvements, and purchase of equipment, land, and existing structures. Capital outlays also include expenditures on additions, replacements, and major alterations to fixed works and structures. Expenditures for repairs to such works and structures, however, are classified as current operating expenditures.

In FY 1993, federal, state, and local governments together invested $52.5 billion in transportation infrastructure (construction) and equipment, only 4 percent of which was *directly* invested by the federal government (see table 2-10). This percentage, however, does not reflect the important role of the federal government in financing transportation investment through grants to state and local governments. Transportation investment was 23 percent of total government investment in FY 1993, up from 17 percent in FY 1983. In constant dollars, government transportation investment grew at an average annual rate of 4.2 percent between FY 1983 and FY 1993, almost four times as fast as total investment (1.1 percent). (USDOC Census 1984; USDOC Census 1996)

Government investment in transportation focused on infrastructure much more heavily than did its investment in other sectors of the economy. Of the total transportation investment, infrastructure accounted for 84 percent in both FY 1983 and FY 1993. Transportation infrastructure accounted for 34 percent of total infrastructure investment in FY 1983, and 38 percent in FY 1993. (USDOC Census 1984; USDOC Census 1996)

Federal, state, and local governments differ somewhat in where they put their transportation

Table 2-11.
Government Transportation Investment by Mode: Fiscal Years 1983 and 1993
(In billions)

Investment	Fixed investment 1983	Fixed investment 1993	Construction outlays 1983	Construction outlays 1993
		Current dollars		
Transportation total	25.4	52.5	21.3	44.0
Highways	18.8	38.4	16.5	34.0
Airports	1.7	6.4	1.3	4.7
Parking facilities	—	0.4	—	0.3
Water transportation and terminals	1.4	1.2	1.2	0.7
Transit	3.6	6.2	2.2	4.3
		Constant 1992 dollars		
Transportation total	34.1	51.3	28.6	43.0
Highways	25.2	37.5	22.1	33.2
Airports	2.3	6.3	1.7	4.6
Parking facilities	—	0.4	—	0.3
Water transportation and terminals	1.9	1.2	1.6	0.7
Transit	4.8	6.1	3.0	4.2

KEY: — = zero or a value too small to report.

NOTES: Numbers may not add due to rounding.
Fixed investment equals outlays for structures (shown above), plus outlays for equipment (not shown).

SOURCE: U.S. Department of Commerce, Bureau of the Census. 1984. *Governmental Finances 1982–83.* Washington, DC: U.S. Department of Commerce, Bureau of the Census. 1996. *Government Finances: 1992–93.* [cited 23 December 1996] Available at http://www.census.gov.

investment dollars. Compared with state and local governments, the federal government spends a higher percent of its direct investment in transportation on equipment and a relatively lower percentage on infrastructure. In FY 1993, infrastructure accounted for 50 percent of the federal government's and 85 percent of state and local governments' investment in transportation. (USDOC Census 1984; USDOC Census 1996)

The lion's share of total transportation investment is for highways—73 percent in FY 1993, almost exactly the same as in FY 1983. Urban transit received $6.2 billion in FY 1993, 12 percent of the total, down from 14 percent of the total in FY 1983 (see current dollars portion of table 2-11). Airport investment grew rapidly during these 10 years, nearly doubling its share of total transportation investment and overtaking transit.

Investment in highway, transit, and airports is heavily slanted toward construction (see table 2-11). Almost 90 percent of public investment in highways in FY 1993 was for construction. For transit, the number was 67 percent, and for airports, 73 percent. (USDOC Census 1984; USDOC Census 1996)

The only mode experiencing a loss of investment in absolute terms between FY 1983 and FY 1993 was water transportation and terminals due to a decrease in construction. Equipment investment, however, increased 67 percent in real terms.

Table 2-12.
Transportation Investment by Mode and Level of Government: Fiscal Years 1983 and 1993
(In billions, after transfers)

	Federal		State		Local	
Investment	**1983**	**1993**	**1983**	**1993**	**1983**	**1993**
			Current dollars			
Transportation total	1.1	2.2	14.6	31.2	9.8	19.1
Highways	0.2	0.7	13.4	28.7	5.3	9.0
Airports	0.3	1.0	0.2	0.8	1.3	4.6
Parking facilities	—	—	—	—	—	0.4
Water transportation and terminals	0.6	0.6	0.2	0.2	0.5	0.4
Transit	—	—	0.9	1.4	2.8	4.8
			Constant 1992 dollars			
Transportation total	1.4	2.1	19.9	30.6	13.4	18.7
Highways	0.3	0.7	18.3	28.1	7.2	8.8
Airports	0.4	1.0	0.3	0.8	1.8	4.5
Parking facilities	—	—	—	—	—	0.4
Water transportation and terminals	0.8	0.6	0.3	0.2	0.7	0.4
Transit	—	—	1.2	1.4	3.8	4.7

KEY: — = zero or a value too small to report.

NOTES: Numbers may not add due to rounding. The data on federal direct investment in transportation in the cited sources are based on information in the *Budget of the United States*. The coverage of many aggregates in the sources, however, is different and not comparable to figures in published budget documents. For example, the analytical report of the budget lists federal direct investment in airports as $0.1 billion in FY 1993, compared with the $1 billion figure shown above.

SOURCES: (1) U.S. Department of Commerce, Bureau of the Census. 1984. *Governmental Finances 1982–83.* Washington, DC.
(2) U.S. Department of Commerce, Bureau of the Census. 1996. *Government Finances: 1992–93.* [cited 23 December 1996] Available at http://www.census.gov.

Government transportation investment differs markedly by modal structure (see table 2-12). In FY 1993, all levels of government invested heavily in highways, but the proportions were quite different, with state governments putting 92 percent of their transportation investment into highways, local governments 47 percent, and the federal government 32 percent. Not only did the states put a higher percentage of their total investment into highways, but their total investment was bigger to begin with; consequently, in FY 1993 the states made 75 percent of the government investment in highways. A significant portion of state and local investment in highways, however, was financed though federal transfers, similar to total transportation investment. (USDOC Census 1984; USDOC Census 1996)

In FY 1993, local governments invested more in airports and urban transit combined than they did in highways, and, indeed, local governments were responsible for over 70 percent of the government investment in these two modes in that year (see box 2-2).

Box 2-2.
Intermodal Facilities and Public Investment

How much have governments invested in intermodal transportation facilities? Currently, robust data are not available to answer this question. Before attempts are made to collect such data or make estimates, it is important to clarify several conceptual issues, particularly the definition of an intermodal transportation facility.

When passengers or freight are moved by more than one transportation mode from origin to destination, this is called intermodal transportation. Aside from trips in private motor vehicles, passenger transportation is usually intermodal, because passengers often cannot complete a trip without using more than one mode. For freight transportation, intermodal service consists of moving products in a container or trailer by a combination of rail plus truck or oceangoing ship, or by truck and air combinations. Also, noncontainerized commodities are moved by combinations of trucks, trains, barges, and pipelines. Although all it takes for a transportation service to be intermodal is to move passengers or freight by more than one transportation mode in a given trip, success in this endeavor is dependent on intermodal transportation facilities.[1]

Following the Bureau of Economic Analysis's practice of classifying fixed assets into structures and equipment, an intermodal transportation facility is defined here as a structure that is built and operated for the purpose of facilitating intermodal transfer of people and goods. Therefore, intermodal facilities are defined by what they are used for rather than by their properties. For example, a rail track connecting railyards in two cities is not very different from one that branches off from the central rail system and extends to an airport or seaport. The latter, however, is an intermodal facility by our definition, but the former is not. Intermodal transportation facilities include rail/marine terminals, other container terminals, on-dock railyards, rail/motor carrier transfer points, rail and road links to off-airport locations, and shuttle bus, taxi stands, and parking facilities at airport terminals, train stations, and bus terminals.

As mentioned above, comprehensive data are currently not available on government investment in intermodal transportation facilities. Reports from business journals and government agencies, however, indicate that both the private sector and governments are increasingly investing in such facilities. Some airports are constructing facilities for intermodal services, many of which are partly financed by governments.

Intermodal investment in public ports is large. According to a Maritime Administration report, the U.S. public port industry invested $12.5 billion from 1946 through 1992 in capital improvements for new facilities and the modernization and rehabilitation of existing ones. (USDOT 1994) Much of this was for intermodal facilities. Two examples are the ports of Long Beach and Los Angeles, the largest U.S. container ports.

[1] Intermodal transportation services may be offered without always requiring large investments in special facilities. For example, a shuttle service may be offered between an airport's passenger terminal and a train station using the existing connecting roads and loading areas.

REFERENCES
U.S. Department of Transportation (USDOT), Maritime Administration. 1994. *Public Port Financing in the United States.* Washington, DC.

Not surprisingly, parking facilities received the smallest public investment, $400 million in FY 1993, three-quarters of which went to construction.

Economic Returns

Government investment in transportation affects the economy in both the short and long term. As a component of final demand, government investment immediately affects employment and production. Changes in the nation's transportation infrastructure influence the growth of the economy and productivity in the long run. This section summarizes and updates the discussion of long-term effects, which were featured in BTS's *Transportation Statistics Annual Report 1995*. (USDOT BTS 1995) A review of several studies on the effects of government investment in transportation shows that many noneconomic or nonmarket benefits to our society, such as national security, were not captured in their calculations of economic returns. Also, rate of return calculations were done with techniques and data that are often subject to criticism.[7]

[7] For a discussion of these criticisms, see Gramlich 1994 and Munnell 1992.

Since the 1980s, a great deal of research has been devoted to assessing the economic returns from government investment in public infrastructure, including transportation infrastructure. Most of these studies examined public capital[8] and its impacts on production at the national, regional, state, or industry levels. Some studies tried to identify and analyze specific types of investment. For transportation, highway capital stock (i.e., existing infrastructure) is the most often studied. An early example is a Congressional Budget Office study, which reported the rates of return for various types of highway expenditures in the 1980s. (CBO 1988) Although the picture is mixed, it is not surprising that very different kinds of investment projects yield quite different returns.

Some research conducted since the late 1980s has tried to estimate the effect of public capital stock on private production and its related costs. The results indicated that public capital stock had a large effect. Output elasticity is one way to estimate this effect. This measure shows how much private sector output changes if public capital stock increases by 1 percent. A 1996 study prepared for the Federal Highway Administration (FHWA) (Nadiri and Mamuneas 1996) offers strong evidence of the many ways highway capital in the United States contributes to the productivity of 35 different industries and the overall economy. In particular, it suggests that the return on the investment of a dollar in highway infrastructure generally has been greater than the return on a dollar of private capital investment. As the Interstate Highway System neared completion in the 1980s, however, the rate of return on highways fell gradually to just under the return on private capital in the economy.

The results of the 1996 FHWA study also indicate that the contribution of highway capital to productivity growth is relatively small in almost all industries and at the aggregate level, except in a few nonmanufacturing industries. Another interesting finding of the study is that highway capital appears to substitute for private capital and labor. In other words, highway investment was found to reduce the demand for labor, private capital, and material inputs in the manufacturing industries, but increased the demand for labor and material inputs and decreased the demand for private capital in nonmanufacturing industries.

It is not easy to generalize from these studies. Although most of the results indicate that public capital stock in general and transportation infrastructure capital in particular have a positive economic contribution to private production and productivity, the results are mixed. Such mixed results pose difficulties for interpretation, because the specific linkages between capital stocks and the economy are not well understood. There is also disagreement about where efforts should be focused. Some argue that the best approach is not to analyze the numbers but to set up institutional structures that permit state and local governments to determine the best approach. (Gramlich 1994) Others argue that more emphasis should be put on encouraging efficient use of the existing capacity. (Winston 1992) This disagreement, however, does not cast doubt on the positive contributions of transportation infrastructure to our economy and society. As one researcher noted: "At this point, an even-handed reading of the evidence—including the growing body of cross-sectional results—suggests that public infrastructure is a productive input which may have large payoffs." (Munnell 1992)

[8] Public capital is defined as equipment, infrastructure, and other durable goods that are financed and managed by federal, state, and local governments.

Data Needs

Additional analysis and supporting data could lead to improved understanding of the relationships between transportation and the rest of the economy, particularly the economic impacts of government transportation investment and transportation infrastructure capital stock. Given the magnitude of highway investment and highway capital, further research in this area could have a big payoff. As shown above, all levels of government make substantial investments in transportation infrastructure other than highways.

The lack of reliable and sufficiently detailed data on the stock of transportation infrastructure impedes understanding of the contribution of public investment in transportation infrastructure to U.S. economic growth. The Bureau of Economic Analysis and other researchers derived their capital stock data using the perpetual inventory method.[9] Inputs to this procedure include original investment flows, average service lives, and retirement patterns. Data on depreciation are needed to estimate net capital stock from gross capital stock.

The Census Bureau is another source of data. Census data offer more details, but are available only in current dollars, which makes analyses of changes over time difficult. Neither data source reflects adjustments that take the quality of infrastructure into account. This impedes analysis of infrastructure capital effects, as both the level of stock and its quality are important.

A thorough investigation of current construction and use of existing intermodal facilities within each transportation mode is a necessary first step for a complete picture of investment in these facilities. Without better data on transportation infrastructure, both investment and capital stocks, a solid understanding of its contribution to the economy is impossible even with sophisticated theories and estimation methods.

Systematic cost analyses of transportation services need to be developed both for passenger and freight transportation. Such analyses would show the cost of transportation services to consumers and businesses, and whether these services are becoming relatively more or less expensive over time, compared with other goods and services. Some data such as BLS's consumer and producer price indices could be explored for this purpose, although the cost data would have to be obtained from other sources.

[9] The perpetual inventory method starts with investment flows in both current and constant dollars. The gross capital stock for a given period is obtained by cumulating past investment and deducting the cumulated value of investment that has been discarded, using estimated average service life and retirement patterns. The net capital stock is equal to the gross stock, less accumulated depreciation on the items in the gross stock.

References

Congressional Budget Office (CBO). 1988. *New Directions for the Nation's Public Works.* Washington, DC. September.

Davis, S.C. and D.N. McFarlin. 1996. *Transportation Energy Data Book: Edition 16*, ORNL-6898. Oak Ridge, TN: Oak Ridge National Laboratory. July.

Gramlich, E.M. 1994. Infrastructure Investment: A Review Essay. *Journal of Economic Literature* 32. September.

Munnell, A.H. 1992. Infrastructure Investment and Economic Growth. *Journal of Economic Perspectives* 6:4.

Nadiri, M.I. and T.P. Mamuneas. 1996. Contribution of Highway Capital to Industry and National Productivity Growth, prepared for Apogee Research, Inc. for the U.S. Department of Transportation, Federal Highway Administration, Office of Policy Development. September.

U.S. Department of Commerce (USDOC), Bureau of the Census. 1984. *Governmental Finances in 1982–83*. Washington, DC.

_____. 1996. *Government Finances: 1992–93*. [cited 23 December 1996.] Available from http://www.census.gov.

U.S. Department of Commerce (USDOC), Bureau of Economic Analysis (BEA). 1996. *Survey of Current Business*. Various issues.

U.S. Department of Labor (USDOL), Bureau of Labor Statistics (BLS). 1984–1994. Consumer Expenditure Survey.

_____. 1995 and 1996. *Monthly Labor Review*. June.

U.S. Department of Labor (USDOL), Bureau of Labor Statistics (BLS), Office of Employment Projections (OEP). 1994. The National Industry-Occupation Employment Matrix, 1983–1993 Time Series. July.

U.S. Department of Transportation (USDOT), Bureau of Transportation Statistics (BTS). 1995. *Transportation Statistics Annual Report 1995*. Washington, DC.

_____. 1997. *Federal State, and Local Transportation Financial Statistics, Fiscal Years 1982–1994*. Washington, DC.

Winston, C. 1995. Efficient Transportation Infrastructure Policy. *Journal of Economic Perspectives* 5:1.